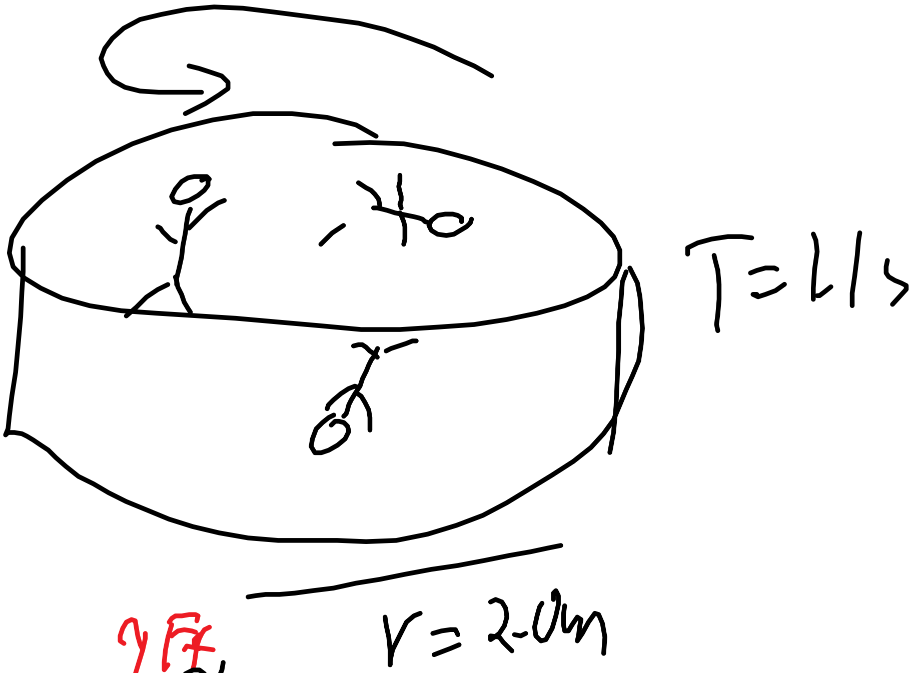
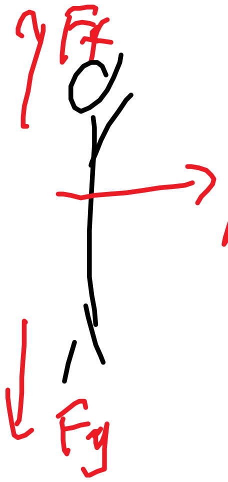
p121 Q14



$\mu = ?$



$R = F_c$

$R = \frac{m 4\pi^2 r}{T^2}$

$F_f \geq F_g$

$\mu \frac{m 4\pi^2 r}{T^2} \geq m g$

$\mu \geq \frac{g T^2}{4\pi^2 r}$

$\mu = 0.103$

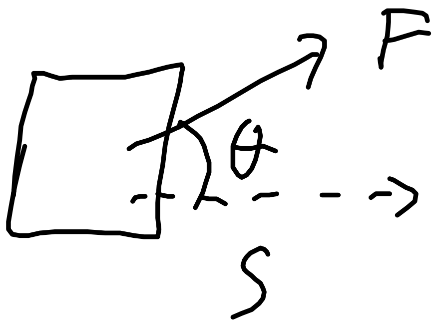
Work and Energy (not on test)

Define:

Work is change in energy is one definition but Energy is the ability to do work. (a circular definition)

Physical work can be defined as the vector dot product of Force and displacement.

$W = F \cdot s$



or
$W = Fs\cos\theta$ where θ is the angle between F and s.

units: Joule, J = Nm

if F is perpendicular to s, then W=0
if F is opposite to s, then W is negative

$W = \Delta Energy$
work done by net force $W_{net} = \Delta E_k$
work done against gravity $W_g = \Delta E_g$
work done against a spring $W_{elastic} = \Delta E_{elastic}$
but F is not constant for elastic objects, so we calculate work as the area under F-s graph

derive energy equations

$W_{net} = F_{net} \cdot s = mas$
from kinematics, $2as = V^2 - u^2$
$mas = m\,1/2\,(V^2 - u^2)$

$W_{net} = 1/2mv^2 - 1/2mu^2 = \Delta E_k = E_{kf} - E_{ki}$

therefore

$E_k = 1/2\,mv^2$

$\Delta E_g = W_g = F_g s = mgs = mg\Delta h$
near Earth
$E_g = mgh$ IB databooklet $E_p = E_g$

keeners: HL only
integral of Fg = $\int GMm/r^2$ $E_g = -GMm/r$ relative to zero at infinity

elastic energy (recall SHM)

$W = integral\ of$ F with respect to s

F=-kx

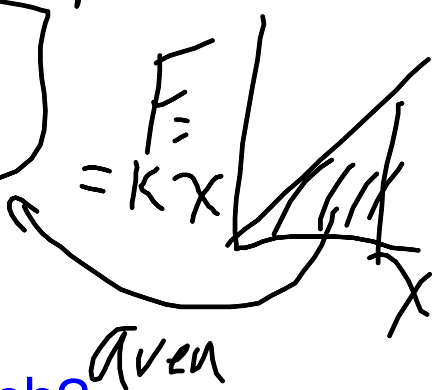
$$W = \int F\,ds$$

$$= \int Kx\,dx$$

add one to exponent

$$E_{elastic} = \frac{1}{2}kx^2$$

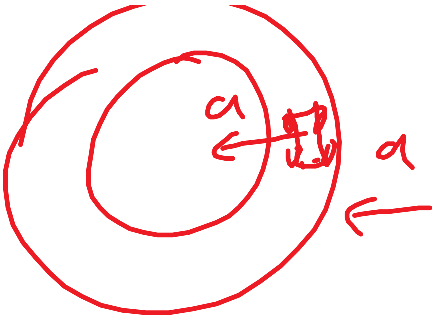
$F = kx$

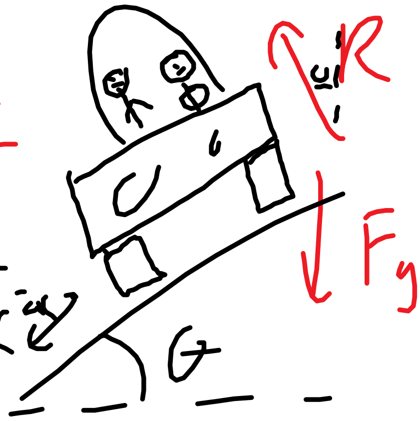


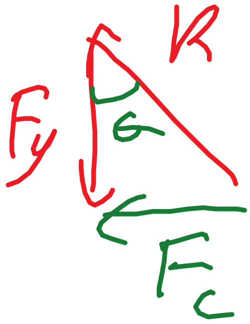
https://www.youtube.com/watch?v=lYc7kHXW0xg

A 60.0 kg jumper jumps from a bridge 50.0m above the water. If the bungee cord is 15.0m

a) What is her gravitational potential energy on the bridge?
b) What is her kinetic energy when she has fallen 15.0m? (before the cord starts stretching)
c) what is the spring constant of the cord(k) if she stops just as her head hits the water?
d) what is her acceleration at the lowest point?
e) where is her acceleration = 0?
f) sketch her s-t graph assuming the spring energy dissipates over 3 bounces.







$\mu R = F_f$

$$\tan\theta = \frac{F_c}{F_y} = \frac{v^2}{rg}$$

$x \quad ma = \mu R\cos\theta + R\sin\theta \quad (a = v^2/r)$

$y \quad 0 = -\mu R\sin\theta + R\cos\theta - Mg$